dicebantur. Sed in neutra scriptores, qui mihi abunde satisfacerent, tunc forte incidebant in manus: nam plurima quidem in iisdem legebam circa numeros, quae subductis rationibus vera esse experiebar; circa figuras vero, multa ipsismet oculis quodammodo exhibebant, et ex quibusdam consequentibus[33] concludebant; sed quare ista[34] ita se haberent,[35] et quomodo invenirentur, menti ipsi non satis videbantur ostendere; ideoque non mirabar, si plerique etiam ex ingeniosis et eruditis delibatas istas artes vel cito negligant ut pueriles et vanas, vel contra ab iisdem addiscendis, tanquam valde difficilibus et intricatis, in ipso limine deterreantur. Nam revera nihil inanius est, quam circa nudos numeros figurasque imaginarias ita versari, ut velle videamur in talium nugarum cognitione conquiescere, atque superficiariis istis demonstrationibus, quae casu saepius quam arte inveniuntur, et magis ad oculos imaginationemque pertineant[36] quam ad intellectum, sic incumbere, ut quodammodo ipsa ratione uti desuescamus; simulque nihil intricatius, quam tali probandi modo novas difficultates confusis numeris involutas expedire. Cum vero postea cogitarem, unde ergo fieret, ut primi olim Philosophiae inventores neminem Matheseos imperitum ad studium sapientiae vellent admittere,
[376] tanquam haec disciplina | omnium facillima et maxime necessaria videretur[37] ad ingenia capessendis aliis majoribus scientiis erudienda et praeparanda, plane suspicatus sum, quandam eos Mathesim agnovisse valde diversam a vulgari nostrae aetatis; non quod existimem eandem illos perfecte scivisse, nam eorum[38] insanae exsultationes et sacrificia pro levibus inventis aperte ostendunt, quam fuerint rudes. Nec me ab opinione dimovent quaedam illorum machinae, quae apud Historicos celebrantur: nam licet

[33] H, A, AT, C, and SGZ: consequentibus. L: consequentiis.
[34] H, C, and SGZ: ista. A and AT: haec.
[35] C: haberent. H, A, AT, and SGZ: habeant.
[36] H, C, and SGZ: pertineant. A and AT: pertinent.
[37] H, AT, C, and SGZ: videretur. A: videatur.
[38] A, AT, C, and SGZ: eorum. Missing in H.

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the paths to the rest.[67] But perhaps in neither of the two did I then encounter writers who fully satisfied me. For, to be sure, I read in them many things about numbers which, once the calculations had been carried out, I found to be true. In a certain manner, they did indeed display many things concerning figures before my very eyes, and from some of them they drew conclusions by means of inferences. None the less, why these things should be so, and how they were discovered, they did not seem to show satisfactorily to the mind itself.[68] I was not surprised, therefore, that even many of the ingenious and erudite, after having gotten interested in these arts, either would quickly neglect them as puerile and vain, or else would, at the very threshold, be deterred from learning them as very difficult and complicated. For there is really nothing more inane than so to occupy ourselves with bare numbers and with imaginary figures that we seem to want to rest content with the knowledge of such trifles, and so to get involved in those superficial demonstrations which are discovered more often through chance than through art and which pertain more to the eyes and to the imagination than to the intellect that, in a way, we break the habit of using reason itself. At the same time, there is nothing more complicated than using such a mode of proof to resolve new difficulties convoluted by confused numbers.[69] But, when I got to thinking, later on, about why it happened, therefore, that the first discoverers of philosophy once wanted to admit no one unversed in mathematics to the study of wisdom[70] – as if this discipline seemed the easiest and most indispensable of all for cultivating the natural intelligence and for preparing it to grasp other more important sciences –, I fully suspected that they had recognized a kind of mathematics quite different from the vulgar one of our own age. Not that I thought that they had had a perfect knowledge of it, for their mad exultations and sacrifices for trivial discoveries clearly show how primitive they must have been.[71] Nor am I shaken in this opinion by certain of their machines which are

[67] The prevailing perception among commentators is that this statement introduces an independent and inserted segment of text, i.e., § 5, which is predominantly of an autobiographical character and which was composed at a substantially different, and, very probably, earlier, time from the preceding paragraphs of this rule.

[68] Read in context, this statement, above all, would appear to indicate that Descartes is criticizing the ordinary mathematics for, among other things, being too synthetic, i.e., overly oriented on the exposition of the known, and thus for not being analytic enough, i.e., too little directed toward the discovery of the unknown. Cf. § 3 of this rule. In this respect, there is a remarkable parallel between Descartes' critique of contemporary mathematics and his critique of contemporary logic. Cf., e.g., R. 10, §§ 4–5.

[69] Cf., e.g., R. 16, §§ 3 and 5.

[70] According to Elias Philosophus, among others, the motto inscribed over the entrance to Plato's Academy was: 'No one ignorant of geometry may enter.' The transliterated Greek is: 'Ageómetrétos médeis eisitó.' Cf. *In Aristotelis Categorias Commentaria*, p. 118, l. 18 f., in *Commentaria in Aristotelem Graeca*, ed. A. Busse, vol. 18 (Berlin, 1900), pt. 1. It is debatable whether Descartes' substitution of 'mathematics' for 'geometry' strengthens or weakens the restriction.

[71] This is perhaps an allusion to, e.g., the alleged hecatomb of Pythagoras (ca. 582–ca. 507) on the occasion of the discovery of 'his' famous theorem (cf. Diogenes Laertius, *Collection of Lives and Opinions of the Philosophers*, bk. VIII, ch. 12); the dedicatory gift of Eratosthenes (ca. 275–ca. 195) on the occasion of the discovery of his mesolabion, an instrument for the determination of mean proportionals (cf. Pappus, *Collected Works*, bk. III, prop. 5); etc.

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fortasse valde simplices exstiterint, facile potuerunt ab ignara et mirabunda multitudine ad miraculorum famam extolli. Sed mihi persuadeo, prima quaedam veritatum semina humanis ingeniis a natura insita, quae nos, quotidie tot errores diversos legendo et audiendo, in nobis extinguimus, tantas vires[39] in rudi ista et pura antiquitate habuisse, ut eodem mentis lumine, quo virtutem voluptati, honestumque utili praeferendum esse videbant, etsi, quare hoc ita esset, ignorarent, Philosophiae etiam et Matheseos veras ideas agnoverint, quamvis ipsas scientias perfecte consequi nondum possent. Et quidem hujus verae Matheseos vestigia quaedam adhuc apparere mihi videntur in Pappo et Diophanto, qui, licet non prima aetate, multis tamen saeculis ante haec tempora vixerunt. Hanc vero postea ab ipsis scriptoribus perniciosa quadam astutia[40] suppressam fuisse crediderim; nam sicut multos artifices de suis inventis fecisse compertum est, timuerunt forte, quia facillima erat et simplex, ne vulgata vilesceret, malueruntque nobis in ejus locum steriles quasdam veritates ex consequentibus acutule demonstratas,
[377] tanquam artis suae effectus, | ut illos miraremur, exhibere, quam artem ipsam docere, quae plane admirationem sustulisset. Fuerunt denique quidam ingeniosissimi viri, qui

[39] A, AT, C, and SGZ: tantas vires. H: tantos vires. L: tantos viros.
[40] H, A, AT, and C: astutia. SGZ: astutitia.

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celebrated by historians.[72] For, allowing that very simple ones may perhaps have existed, they may easily have been raised to the level of marvels by the ignorant and wonder-loving multitude. But I am convinced that certain primary seeds of truths implanted by nature in human natural intelligence – seeds which we have stifled in us through our daily reading and through our hearing so many different errors – had so great powers in that primitive and pure antiquity that – by means of the same light of the mind by means of which they saw that virtue is to be preferred to pleasure, and the good, to the useful, even if they did not know why this were thus – the first discoverers also recognized the true ideas of philosophy and of mathematics, although they were not yet able to grasp these sciences perfectly.[73] To be sure, even now some traces of this true mathematics seem to me to be apparent in Pappus[74] and in Diophantus,[75] who, admittedly not of the earliest age, have still lived many centuries before these our own times. None the less, I have come to believe that this mathematics was later suppressed by these writers themselves with a kind of pernicious cunning.[76] For, as many artificers are known to have done with respect to their own inventions, they may perhaps have feared that their mathematics, because it was very easy and simple, would be depreciated if it were divulged to the commonality.[77] In lieu of it, they have preferred to show us some sterile truths cleverly demonstrated from inferences, as it were, the results of their art, in order that we might admire them, rather than to teach us this art itself, which might have completely dispelled the admiration.[78] In the present age,

[72] If 'machinae' are understood in the metaphorical sense of 'devices', then this is possibly an allusion to, e.g., the mesolabion of Eratosthenes; the conchoidal circle or curve of Nicomedes (fl. ca. 250 B.C.), by which he was able to trisect an angle and to double a cube; the *regula versatilis* of Hero(n) of Alexandria (fl. A.D. first century), which enabled him to derive the area of a triangle (cf. Pappus, *Collected Works*, bk. III); etc. On the other hand, Descartes is probably thinking of machines in the literal sense, e.g., Hero(n)'s aeolipile, which was a pneumatic instrument illustrating the force with which vapor generated by heat in a closed vessel rushes out through a narrow opening and which is thus reported to have been the first steam-powered engine. Cf., e.g., AT, I, 528; AT, IV, 224; AT, VI, 265; etc.

[73] Cf. § 3 of this rule. Cf. also *Discourse*, pt. V, § 1, and VI, 3, *Meditations*, M. III, §§ 7, 11, and 37, and AT, III, 424, on the notion of 'innate ideas' or 'laws'. On the other hand, the traditional Scholastic maxim is: 'Nihil est in intellectu, quod non fuerit prius in sensu.' I.e.: 'Nothing is in the intellect which has not first been in the senses.' Cf. Aquinas, *Quaestiones disputatae de veritate*, ques. 2, art. 3, obj. and resp. 19. In the *Discourse* the maxim is formulated thus (AT, VI, 37): '… les philosophes tiennent pour maxime, dans les écoles, qu'il n'y a rien dans l'entendement qui n'ait premièrement été dans le sens …'. Cf. also *Meditations*, M. VI, § 6: '… facile mihi persuadebam nullam [ideam] plane me habere in intellectu, quam non prius habuissem in sensu.'

[74] The Greek geometrician Pappus of Alexandria (fl. ca. A.D. 300) recorded and extended the results of his predecessors, including Euclid of Alexandria (fl. 300 B.C.) and Apollonius of Perga (fl. 247–205). The Latin edition of the extant books of his *Mathematical Collections* in 1588 helped stimulate a revival of geometry in the next century, and Pappus figures prominently in Descartes' *Geometry*, which practically begins with the latter's solution to the former's locus problem for four or more lines.

[75] The Greek algebraist Diophantus of Alexandria (fl. A.D. 250) was a pioneer in the solution of a type of indeterminate algebraic equation where one seeks integer values for the unknowns. His chief work, the *Arithmetic* (six of whose thirteen books are extant), introduces symbolism into Greek algebra.

[76] Cf. § 3 of this rule.

[77] Cf. R. 3, § 1.

[78] In other words, the ancient mathematicians themselves practiced the analytic method, but they handed down synthetic results to others – cf., once again, § 3 of this rule.

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eandem hoc saeculo suscitare conati sunt: nam nihil aliud esse videtur ars illa, quam barbaro nomine Algebram vocant, si tantum multiplicibus numeris et inexplicabilibus figuris, quibus obruitur, ita possit exsolvi,[41] ut non amplius ei desit perspicuitas et facilitas summa, qualem in vera Mathesi esse debere supponimus. Quae me cogitationes cum a particularibus studiis Arithmeticae et Geometriae ad generalem quandam Matheseos investigationem revocassent, quaesivi imprimis, quidnam praecise per illud nomen omnes intelligant, et quare non modo jam dictae,[42] sed Astronomia etiam, Musica, Optica, Mechanica, aliaeque complures, Mathematicae partes dicantur. Hic enim vocis originem spectare non sufficit: nam cum Matheseos nomen idem tantum sonet quod disciplina, non minori jure, quam Geometria ipsa, [caeterae omnes][43] Mathematicae vocarentur. Atqui videmus neminem fere esse, si prima tantum scholarum limina tetigerit, qui non facile distinguat ex iis quae occurrunt, quidnam ad Mathesim pertineat, et quid ad alias disciplinas. Quod attentius consideranti tandem
[378] innotuit, illa omnia tan|tum, in quibus aliquis[44] ordo vel mensura examinatur, ad Mathesim referri, nec interesse utrum in numeris, vel figuris, vel astris, vel sonis, aliove

[41] H, AT, C, and SGZ: exsolvi. A: excoli.
[42] H, AT, C, and SGZ: dictae. A: dicta.
[43] Cf. C and SGZ, which insert: [caeterae omnes]. Cf. the corresponding footnote in AT: 'Ne manque-t-il pas ici quelque chose? Par exemple: *omnes* ou *caeterae disciplinae*?'
[44] H, C, and SGZ: aliquis. Missing in A and in AT. N: enige.

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finally, there have been some very ingenious human beings who have tried to revive this art.[79] For it seems to be nothing other than that art which they call by the barbaric name 'algebra',[80] if only it could be so freed from the multiple numbers and from the inexplicable figures by which it is overwhelmed[81] that it would no longer lack that greatest perspicuity and facility which we suppose that there should be in the true mathematics.[82] Once these thoughts had recalled me from the particular studies of arithmetic and of geometry to a general investigation of mathematics, I inquired, above all, as to what precisely all understand by the term 'mathematics',[83] and as to why, not only the aforementioned arithmetic and geometry,[84] but also astronomy,[85] music,[86] optics,[87] mechanics,[88] and several other disciplines,[89] are called 'parts of mathematics'. For here it is not enough to look at the origin of the word. Namely, since the word 'mathematics' merely means the same as 'discipline',[90] all these other disciplines would have no less right to be called 'mathematics' than does geometry itself. Yet we see that there is almost no one, if he has reached even the first grades of the schools, who could not easily distinguish, among the things that occur to him, between what would pertain to mathematics and what would pertain to the other disciplines. Considering this more attentively, I realized, finally, that all those things only are referred to mathematics in which some order or measure is examined, and that it is irrelevant whether such measure were to be sought in numbers or in figures or in stars or in sounds or in any

[79] It is possible that this is an allusion to, e.g., the French mathematician François Vieta (1540–1603), whose *In Artem Analyticem Isagoge* (1591), due to its revolutionary understanding of the formal, represents the first truly modern contribution to algebra: Compare and contrast the Greeks' concept of 'arithmos', i.e., 'number' intending a number of *things*, with Vieta's concept of 'numerus', i.e., 'number' intending a *concept* of quantity. Cf. *Discourse*, pt. II, §§ 6–12 (AT, I, 479–480, e.g., notwithstanding). On Descartes on Vieta cf. Letters to Mersenne, Dec., 1637 (?), and Jan., 1638, To Mydorge, Mar. 1, 1638, To Mersenne, Mar. 31 and Jun. 29, 1638, To Huygens, Aug. 1638, To Mersenne, Nov. 15, 1638, Feb. 20, 1639, and Aug. 30, 1640, To Unknown, Jun. 1645 (?), and To Mersenne, Nov. 2, 1646.

[80] Cf. § 3 of this rule. The Arabic is '*al-jabr*': '(the science) of reuniting' (*al* [the] + *jabr* [reunification, bone-setting]).

[81] It is possible that this is a reference to, e.g., the German mathematician and astronomer Christoph Clavius (1537–1612), whose contributions to algebra (cf., e.g., *Algebra* [1608/1609/1612]), arithmetic, and geometry had earned him the reputation of being 'the Euclid of his century' (cf., e.g., Descartes, Letter to Mersenne, Nov. 13, 1629, and AT, IV, 730–731).

[82] Descartes' own algebraic notation is, of course, still much closer to the more primitive and cluttered one of Clavius than to the more advanced and straightforward one of Vieta.

[83] 'Mathematics' translates 'mathésis', which is from the Greek and means 'learning'.

[84] The list now beginning reads like a systematic anticipation of several of Descartes' own long-term research interests. Cf., e.g., *The Geometry* (1637) (AT, VI, 369–485).

[85] Cf., e.g., *Meteorology* (1637) (AT, VI, 231–366) for some thematic overlapping.

[86] Cf., e.g., *Compendium of Music* (1618) (AT, X, 89–141).

[87] Cf., e.g., *Dioptrics* (1637) (AT, VI, 81–228).

[88] Cf., e.g., Letter to Huygens, Oct. 5, 1637 ('An Explanation of the Machines by means of which a Small Force Can Be Used to Lift a Heavy Weight') (AT, I, 435–447). Also, the correspondence between Descartes and Beeckman from Jan. 24 to March 26, 1619, appears to indicate that the former may have then been working on a kind of 'treatise on mechanics'.

[89] Including considerable portions of natural philosophy – if not physics in general. Cf., e.g., *The World or The Treatise on Light* (1632–1633) (AT, XI, 3 ff.) and *Principles of Philosophy* (1644) (AT, VIII/1, 1–329).

[90] 'Discipline' translates 'disciplina', which derives from the verb 'discere', meaning 'to learn'.

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